GLAST LAT BALLOON FLIGHT PLAN	Document # **xx-00001-xx**	Date Effective 9/25/00
	Prepared by(s) David Thompson	Supersedes None
	Subsystem/Office Balloon flight	
Document Title GLAST Balloon Flight Engineering Model - Plan for Balloon Flight		

Gamma-ray Large Area Space Telescope

(GLAST)

Large Area Telescope (LAT)

Balloon Flight Engineering Model (BFEM)

Balloon Flight Plan

DRAFT

DOCUMENT APPROVAL

Prepared by:

____

David Thompson Date

Balloon Flight Scientist

Approved by:

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Tim Thurston Date

LAT Systems Engineering

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William E. Althouse Date

LAT Project Manager

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Peter Michelson Date

Instrument Principal Investigator

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Tune Kamae Date

Instrument Technical Lead

____

Steve Ritz Date

Instrument Scientist

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Draft	9/26/00	

APPLICABLE DOCUMENTS

Documents that are relevant to the planning for the GLAST LAT balloon flight include the following:

"Report on the GLAST LAT Balloon Test Flight Objectives," July 12, 2000

GLAST-BFRD-1, "LAT Balloon Flight Requirements Document," August 8, 2000

"Balloon Flight Objectives and Constraints", June 10, 2000

"Balloon Flight Budget," September 11, 2000

"Balloon Power Systems and Packaging Concepts," Sept 14, 2000

"Draft Mass and Power Budget", Aug 10, 2000

"Conventional Balloon Flight Support Application, July 27, 2000

CONTENTS

1. Balloon Flight Top-Level Plan

1.1 Introduction

This document combines parts of several others that have been written during planning for the flight of the GLAST LAT Balloon Flight Engineering Model (BFEM). Section 1 describes the top-level plan: outline, hardware, and programmatics. The objectives for a balloon flight are described in Section 2. Sections 3 and 4 show summaries of power, mass, and cost for the balloon flight, with links to details of these parameters. Section 5 contains selected key pages from the application to NASA for a balloon flight in June, 2001. The objectives can be met by a successful flight of a single GLAST tower on a high-altitude scientific balloon. Only a few hours of data with all subsystems operating together can provide a wealth of information about background and atmospheric gamma radiation, enough to demonstrate the ability of GLAST to operate in a high-background space environment.

Achieving a successful balloon flight is not trivial, but it can be managed by drawing extensively on existing hardware, software, and experience. This document outlines the basic approach for detectors, electronics, supporting equipment, and data handling, describes an organization, and proposes a schedule.

1.2 Hardware and Data Handling

Detectors

The detector subsystems will largely be upgrades of the ones used for the 1999 beam test - the same ACD scintillators, the same calorimeter CsI, and the same Si strip tracker will be used. Changes needed are largely to handle the potential shock (up to 10 G) when the parachute opens or the payload hits the ground.

Two additional detectors will be added: (1) a set of external scintillator targets, which will provide tags for cosmic ray interactions that may produce gamma rays. These targets represent active "sources" of gamma rays that can be detected against the atmospheric background of gamma rays and cosmic rays. These detectors will be provided by colleagues from Japan. (2) a magnetometer (and possibly an inclinometer if we choose to change elevation during the flight) to measure the azimuth of the payload. Such devices are available from other balloon programs at GSFC or NRL.

Figure 1 shows schematically the hardware for the balloon flight and who is responsible for each part of the hardware.

Electronics

Significant improvements have been made in the data acquisition electronics that were used for the 1999 beam test. It is these improved electronics that will be used for the balloon flight. In particular, all the tower electronics modules (TEM) and the main processor will be located in one crate, to improve data flow and increase the data throughput rate to that expected for the balloon environment. Some additional modifications will be required in order to handle housekeeping readouts and control of configurations of the detectors, since commanding capability is very limited in a balloon flight.

A new set of electronics, the Balloon Interface Unit (BIU) is required to handle the data and command transfer to and from the transmitter/receiver (which is provided by the National Scientific Balloon Facility, NSBF). The BIU will be built by NRL, based on an existing system developed for balloon payloads at GSFC. A corresponding command encoder/data decoder will be provided for the equivalent processing on the ground, again based on an existing system.

Supporting Equipment

In order to minimize the potential problems of near-vacuum on the detectors and electronics, the GLAST tower and its electronics will be housed in a 1-atmosphere pressure vessel. Two existing pressure vessels have been identified at Goddard. SLAC will make necessary modifications in the one chosen, in order to support the GLAST equipment.

A thermal analysis will be performed to determine whether any active thermal control is needed for the instrument. If necessary, a simple cooling system can be built.

The pressure vessel containing the GLAST tower will be supported on a gondola built from a nearly-complete spare of a gondola flown many times by the GSFC low-energy gamma-ray group. A decoupling swivel, also provided by the GSFC group, may be used to disconnect the rotation of the balloon from the rotation of the payload. No active control of the azimuth is planned.

Data handling

Timely analysis of both real-time and complete data sets will be important to monitoring and determining the success of the flight. Because the downlink telemetry is limited (probably 128 kbits/s), the plan is to record all data for each Level 1 trigger on-board, while at the same time transmitting some fraction of those data to the ground for monitoring purposes. The telemetered data will also be recorded as a back-up.

Ground Support Equipment (GSE) with real-time displays of housekeeping parameters, rates, and event data will be based on improved versions of the ones used for the 1999 beam test. A complete data processing system, capable of reconstructing tracker events, identifying gamma rays, and computing live time, exposure, and fluxes, will be developed as part of a Mock Data Challenge and will be applied to the balloon data.

Figure 2 shows an overall data flow planned for the balloon flight.

1.3 Programmatics

A Balloon Flight Working Group was established. This group includes D. Thompson (overall coordination and science management), G. Godfrey (instrument integration and test), and S. Williams (systems engineering and resources management), as well as representative from GLAST subsystems. The group is responsible to W. Althouse, the GLAST LAT Project Manager. Weekly VRVS Conferences of this group started in July.

The organization proposed for implementing the balloon flight is an integrated product team led by D. Thompson, G. Godfrey, and S. Williams. Subsystem refurbishment and integration will be performed within the existing GLAST organizational structure. Within each subsystem, a specific point of contact will be responsible for the balloon flight activity and will report to D. Thompson. The balloon flight management, subsystem points of contact, and some of the staffing are shown below. No single individual with responsibilities for GLAST flight instrument development will be dedicated fulltime to the balloon flight.

Organization

BF Scientist:	*David Thompson*
BF System Engineering:	*Scott Williams*
BF Instrument Integration:	*Gary Godfrey*
BF Flight Software:	*JJ Russell*, Tony Waite, Dan Wood, Dave Lauben
BIU	*Michael Lovellette*, Dan Wood
BF Science Data Processing:	*Richard Dubois*
BF GSE/IOC:	*Scott Williams*, Dave Lauben
BF Electrical Systems:	*Gunther Haller*, *Roger Williamson*, James Wallace, Bob Bumala
BF Active Target	*Tune Kamae*
BF Logistics:	*David Thompson*
BF Tracker	*H. Sadrozinski*
BF Calorimeter	*N. Johnson*
BF ACD	*A. Moiseev*

Schedule

A schedule is shown below. Principal dates include the September design review, January subsystem delivery to SLAC for integration, and June launch date. Preliminary results are intended to be available prior to the Instrument PDR in August 2001.

GANTT chart with details by Roger Williams at
http://giants.stanford.edu/balloon/balloonschedule.pdf

August, 2000	BF requirements review
	BFEM TKR interface and S/W tests at UCSC
	BFEM ACD interface and S/W tests at GSFC
September, 2000	BFEM design review
October-November, 2000	Electrical integration tests at GSFC, NRL and UCSC for ACD, CAL, BIU, TKR, and gondola electronics.
December, 2000	BF pre-integration review
January, 2001	All subsystems ship to SLAC. Receiving and bench tests.
	Gondola assembly at GSFC
February, 2001	Mechanical/Electrical integration including active targets
March, 2001	Software integration
April, 2001	Ship to GSFC, Gondola integration
May, 2001	Ship to Texas
June , 2001	Flight
July , 2001	Data analysis and preliminary performance report

Resources

Manpower for the BFEM development has been largely identified in the Balloon Flight Working Group.

Funding for the necessary mechanical, electrical, and software development, BFEM integration, and balloon flight support was included in the total AO budget of $1,057,000.

See section 4 for an updated budget.

Management Philosophy

Because the balloon flight is a one-time effort using largely existing hardware, it does not require the same level of detailed management as a spaceflight instrument. We expect each subsystem to assume responsibility for delivering and testing a working subsystem that has had its interface tested and then to support any work needed to assure that the full instrument will perform as needed for the balloon flight.   We plan three reviews:

1. Design Review. This document represents the design information to be reviewed. It will be made available to the full GLAST collaboration for comment.

2. Pre-integration Review. Each subsystem will document its preparations and interface tests. The combined document will be the substance of the review material. We request a review team to study and approve this work before the subsystems are shipped to SLAC.

3. Pre-flight Review. The Balloon team will document the tests of the integrated tower and describe the plans for the flight and subsequent data analysis. The full GLAST team will have the opportunity to review this material.

GLAST Balloon Flight Engineering Model (BFEM) - Flight Hardware

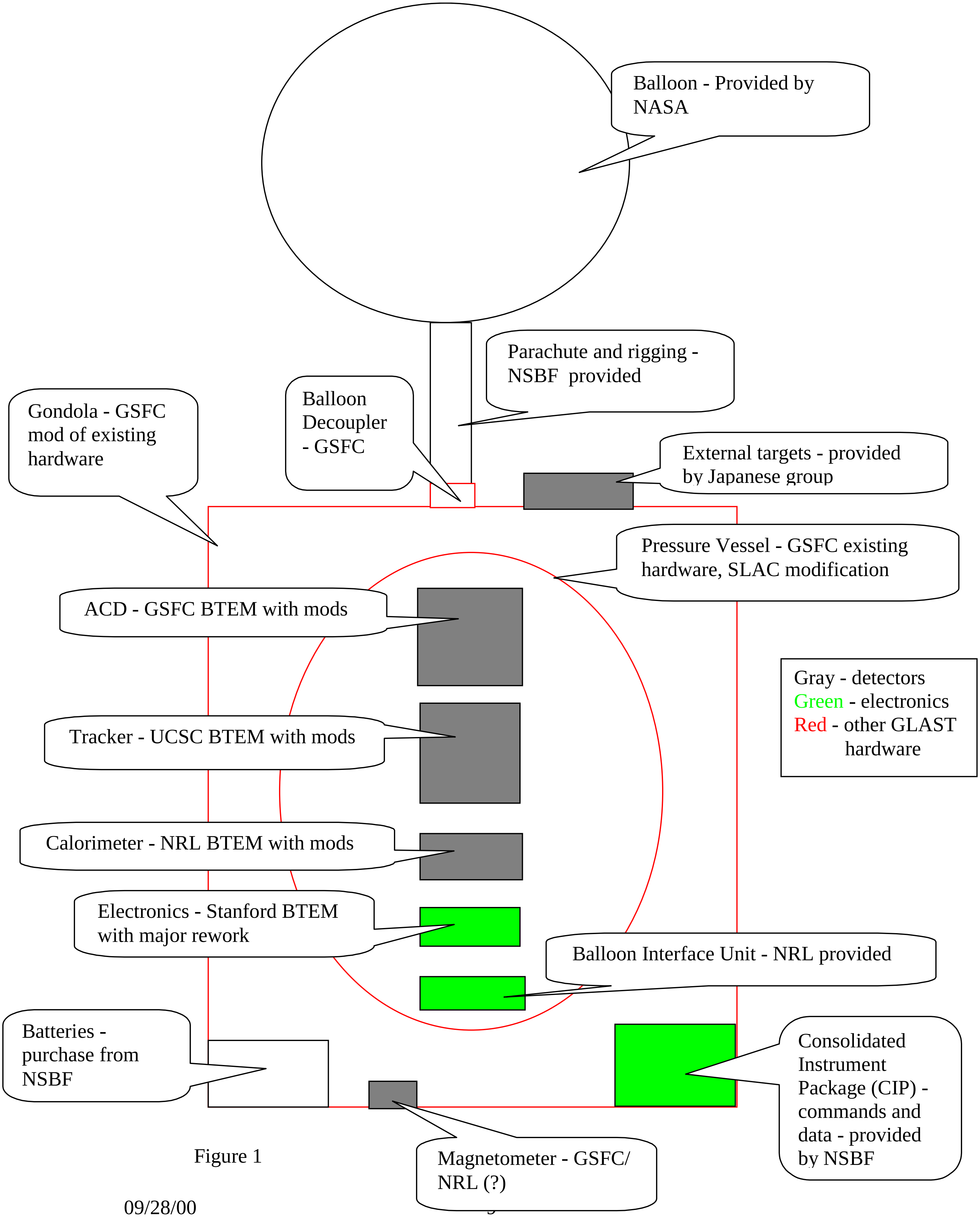

Figure 1

GLAST Balloon Flight Top-Level Data and Command Flow

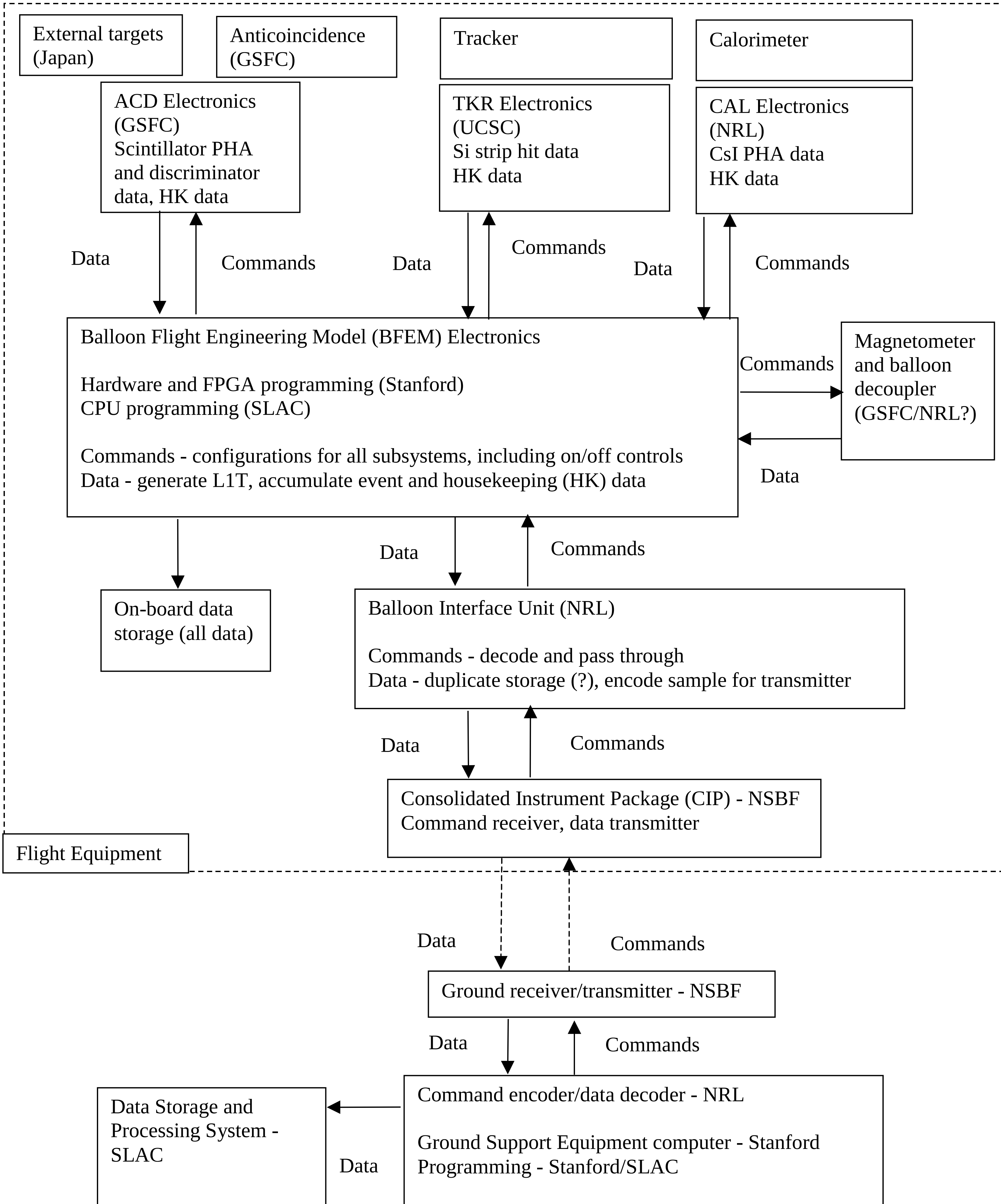

Figure 2

2. Balloon Test Flight Objectives

From: "Report on the GLAST LAT Balloon Test Flight Objectives," July 12, 2000
Balloon Flight Objective Working Group
(Richard Dubois, Gary Godfrey, Gunther Haller, Neil Johnson, Robert Johnson, Tune Kamae, Jonathan Ormes,
Steve Ritz, J.J. Russell, Dave Thompson, Roger Williamson, and Scott Williams)

2.1 History and Purpose

Balloon test flight of an updated Beam Test Engineering Model , or Balloon Flight Experiment Model (BFEM) has been proposed in our Response to the AO (see Fig.2.3.1 in Vol.1 p.54 and Fig.2.3.2 in Vol.1 p.57), as a test process and a technical interim goal (see Section 2.4.3 Sub-orbital Flight of Beam Test Engineering Model in Vol.1 p.65). The date proposed for the flight was April 13 to April 26 of 2001.

External schedule constraints have changed since our proposal submission: in particular, the period of availability of our identified gondola and support group has shifted due to NASA funding decisions. The GLAST-LAT engineering model and flight model design work has begun and some subsystems find preparation for the balloon test flight can potentially divert their work force. To make the balloon test flight most effective within the total scope of the GLAST-LAT project, its objectives and schedule need to be re-examined. This document defines the objectives in the above perspective and proposes the preferred schedule for the flight of BFEM.

2.2 Objectives of the Balloon Test Flight

Since the beginning of the collaboration formation, the merit a balloon test flight can bring has been widely recognized. A balloon flight will give an excellent check on the overall design and will reduce mission risk by testing the instrument in a space-like charged particle environment. On the other hand, well-controlled beam tests are the best way to validate instrument design and performance characteristics. Because of limitations in budget, time, and human resources, the balloon flight instrument has to be based on the beam test tower that will be different significantly from the flight model tower design. In the overall scope of validating the flight instrument design, we will rely on beam tests and cosmic-ray tests as well as the balloon test flight.

The purpose of the balloon test flight is to expose the prototype tower (BFEM) closest practical to the flight version of GLAST-LAT to a charged particle environment similar to the space and accomplish the following objectives:

a) Validate the basic LAT design at the single tower level.

b) Show ability to take data in the high isotropic background flux of energetic particles in the balloon environment.

c) Recording all or partial particle incidences in an unbiased way that can be used as a background event data base.

d) Find an efficient data analysis chain that meet the requirement for the future

Instrument Operation Center of GLAST.

2.3 Estimate of Time and Human Resource Required for the Balloon Test Flight

We have estimated the time requirement after completion of all balloon flight subsystems in Table below. With a contingency of 20 days, the minimum time required is about 5 months. Human resource requirement is shown in the Table (right-most column). A dedicated balloon team is to be formulated soon, who will plan and execute the test flight. The team will need several experienced scientists and engineers. When assembly starts about 4 months before the flight, nearly 5 postdocs and graduate students will be needed. These postdocs and graduate students will simulate performance and analyze data under supervision of the Balloon Team.

Table: Preliminary Schedule for the GLAST-LAT Balloon Test Flight

Testing of the subsystem for the Balloon Flight Eng. Model		Subsystem members
Shipment to SLAC	2 days	
Assembly of the BFEM	5 days	Balloon –Team + 2-3 tech
Test on the BFEM (Hardware)	5days	B-Team + ~3 PD/grad
Test on the BFEM (Software)	24days	B-Team + ~2 PD/grad
Shipment to GSFC	7 days	
Assembly of BFEM in gondola	5 days	B-Team + 2-3 tech
Test of the full balloon payload (Hardware)	14 days	B-Team + 3 PD/grad
Test of the full balloon payload (Software)	24 days	B-Team + 2PD/grad
Shipment to NSBF	5 days	
Balloon flight preparations (incl. Waiting)	12 days	B-Team + 5 PD/grad
Launch and recovery	1 day	B-Team + 5 PD/grad
Contingency	20 days	
Subtotal for the pre-flight preparation	125days	
Post flight test on the instrument	5 days	B-Team + 5PD/grad
Shipment to GSFC	2 days	
Disassembly of the gondola	2 days	B-Team + 2-3 tech

Shipment to subsystem groups	2days
Total	136days

2.4 Expected Counting Rates

We expect the background to be worse for BFEM in the balloon environment than for the full flight model in the low earth orbit. A crude estimate of the signal rate has been done for astronomical sources and a simple Monte Carlo simulation has been run for an artificial target to be placed above BFEM. We note here that these estimations largely depend on the BFEM configuration: The configuration assumed here has 16 layers of 3.5% radiation thickness and ACD in anti-coincidence. All calculations below need to be improved by better Monte Carlo simulations.

<u>Atmospheric photon background rates and potential astronomical targets</u>

a) Assume an effective area of 240cm**2 for gamma-rays entering from the top surface with E>100MeV. We then get the following rates when BFEM is pointing to the zenith:

Gamma-flux (E>100 MeV downward-moving at 3 g/cm2) = 3 x 10-3 ph/cm2/s/sr for Palestine (Thompson, 1974).

Gamma-flux (at the horizon) = 3 x 10-2 ph/cm2/s/sr

Gamma-flux (upward-moving) = 2 x Downward-moving flux

b) Assume a FOV of 4sr and 4 times larger effective area in total (4 side surfaces included) for both downward and upward photons, the trigger rate by photons will be: (We assume that BFEM is pointed to the zenith and the horizontal flux contribute little.)

All surfaces (a factor around 4) x 240(cm2) x 4(sr) x (1+2) x 3 x 10-3 ph/cm2/s/sr
= 40ph/s for zenith pointing at 3g/cm2
= 400ph/s for horizontal pointing at 3g/cm2
= 60ph/s for zenith pointing at 5g/cm2
= 600ph/s for horizontal pointing at 5g/cm2

c) Photons from astronomical targets assuming flights in Palestine TX.

E>100MeV flux (EGRET 3rd Catalog)

Crab total	0.23 x 10-5 ph/cm2/s
Geminga (about 15deg away from Crab)	0.35 x 10-5 ph/cm2/s

240cm2 gives 1.3 x 10-3 ph/s or 5/hr (Crab+Geminga)

E>50MeV flux (Extrapolation based on formula in J.M.Fiero's thesis)

Crab total	0.50 x 10-5 ph/cm2/s
Geminga	0.47 x 10-5 ph/cm2/s

240cm2 gives 2.3 x 10-3 ph/s or 8/hr (Crab + Geminga)

<u>Gamma-rays from pi-zeros generated by proton interactions in artificial targets</u>

Assume: Proton flux (T>5GeV at Palestine) = 5 x 10-2/cm2/s

A block of grqphite (10X10X10cm**3, 2.26kg) at 1.4m above ACD will generate

about 100 photons with E in calorimeter >50MeV and with >16 hits in tracker
about 50 more photons with E in calorimeter >10MeV and with >6 hits in tracker
both per 300k protons (T > 5 GeV).

If we use 17 plastic scintillator blocks (7x7x10cm3 each) as the targets all at 1m from ACD,

E in calorimeter >50MeV with >16 hits in tracker = about 600 photons

(composition of 17 targets: 1 target at theta=0, 8 at about theta 30, 8 at about theta 60)

Charged particle counting rate

Besides the high-energy proton flux, we will encounter more abundant albedo protons and electrons. These fluxes are given in the report by Allan Y. Tylka (May 12, 2000). Relevant data are summarized here. (Note we used the geometric area of BFEM here.)

(Primary proton flux) Flux(T>5GeV)[/cm2/s] = 5 x 10-2/cm2/s (all downward moving)
Flux(T>5GeV)[/BFEM/s] = 200-300/s (downward moving but may enter from side)
(Albedo proton flux)
Flux(theta) [/cm2/sr] (integrated over E) proportional to 1+0.6*sin(theta)
Flux(50-200MeV)[/BFEM/s] = 200-300/s (upward moving protons within 4sr)
Flux(E) [/cm2/sr/MeV] proportional to E**(-2) (upward moving protons)
Flux(50-200MeV)[/BFEM/s] = 130-200/s (downward moving protons within 4sr)
Flux(E) [/cm2/sr/MeV] proportional to E**(-1.5) (downward moving protons)
Flux(100MeV, upward) = ~1.5* Flux(100MeV,downward)
Flux(50-200MeV)[/BFEM/s]=> a few 100/s (side-entering protons)
(Albedo electron flux)
Flux(electron, E<1000MeV)=10*Flux(proton, E<1000MeV)
Flux(50-200MeV)[/BFEM/s] = 2k-3k/s (upward moving electrons within 4sr)
Flux(50-200MeV)[/BFEM/s] = 1.3k-2k/s (downward moving electrons within 4sr)
(Particles create by interactions)
Need simulations but will be significantly less than the direct flux.

2.5 Data Taking Strategy

In accordance to one important objective (Item c) in Section 2), the DAQ system should be able to record a large data volume. One crude estimate of the total hits (defined as 3 contimuous x+y tracker layer hits) is that of protons and electrons with energy sufficient to penetrate more than 3 trays: about 2-3kHz. Further study is needed here.

2.6 Flight Operating Plan

- Launch, 1.5 – 2 hours to reach float altitude at 110,000 to 125,000 ft.
- Take data during ascent pointing towards zenith and for 30 minutes at float
- Float for about 8 hours at a few fixed zenith angles (incl. horizontal pointing) and a few fixed azimuth angles.

- Detach from the balloon and recover by using the attached parachute.

2.7 Recommended date for the balloon test flight

We note here that the beam test experiment module needs a substantial upgrading: eg., the module will be placed in a pressure vessel, various mechanical support structures need to be implemented, the DAQ needs be upgraded substantially to take high counting rate, data link to the gondola need to be implemented. Besides the upgrade work, a new gondola may need be assembled out of the spare GRIS gondola parts if the GRIS gondola is not available for our use

The optimum date for GLAST-LAT will be late June to early July of Year 2001.

3. Power and Mass Estimate

From: "Draft Mass and Power Budget", Aug 10, 2000

BFEM/Gondola Power and Mass Estimate

Item	Unit Mass (kg)	Uncertainty (kg)	Total Mass (kg)	Unit Power (W)	Uncertainty (W)	Total Power (W)
DAQ	53.4	18.7	72.1	228.6	114.3	342.9
ACD	43.0	12.0	55.0	40.0	10.0	50.0
CAL	103.0	28.8	131.8	5.0	1.3	6.3
TKR	23.0	6.4	29.4	10.0	2.5	12.5
BIU	12.5	4.4	16.9	67.0	33.5	100.6
Gondola	580.0	145.0	725.0	12.0	6.0	18.0
TOTALS	**814.9**	**215.4**	**1030.3**	**362.7**	**167.6**	**530.3**
Uncertainty		**26%**			**46%**	

Power details by Bob Bumala at

http://lheawww/users/djt/BALLOON/balloon_power.pdf

4. Budget Summary

From: "Balloon Flight Budget," Sept. 11,2000

Subsystem	WBS	Description	Budget (FY99$)
Science	4.1.3.8		11,453
Tracker	4.1.4.6	Refurbishment, upgrade	66,763
Calorimeter	4.1.5.10	Refurbishment, upgrade	280,118
ACD	4.1.6.7	Refurbishment, upgrade	93,660
DAQ	4.1.7.11	Improved system	209,793
BIU	4.1.7.11.3	New interface	165,706
I&T	4.1.9.5	Integration, balloon flight logistics, balloon flight support	219.377
IOC/GSE	4.1.11.6	New interface	85,443
TOTAL			**1,132,313**

Budget details by Scott Williams at
http://giants.stanford.edu/~scott/balloon/BFBudget_000911.pdf

5. Balloon Flight Application - Filed with NSBF July 27, 2000 - Key Pages

CONVENTIONAL

BALLOON FLIGHT SUPPORT APPLICATION

FISCAL YEAR 2001

The following information is requested regarding your needs for NASA/NSBF balloon flight support. Please type or print legibly and return to the NSBF. Please contact NSBF for "LDB Flight Application Form" if you're submitting for Long Duration Balloon Flights.

PART I

1. Principal Scientific Investigator:_____David J. Thompson___________________

   Organization and Mailing Address: __Laboratory for High Energy Astrophysics__
   ___Code 661, NASA Goddard Space Flight Center, Greenbelt, MD 20771_________

   Telephone: __(301) 286-8168______ Telex or Telefax: (301) 286-1682

   E-Mail Address:______djt@egret.gsfc.nasa.gov_____________________

2. Project Officer or Delegate Familiar with Engineering Aspects of Experiment:
   ____same, for present____

   Organization and Mailing Address: ___________________________________
   ____

   Telephone:_________________ Telex or Telefax:________________________

   E-Mail Address: ____

3. Source of Funding (Research Grant):___839-40-11-01____________

4. I have plans for balloon launches within the periods specified on the attached letter: Yes__X____; No______.
   If no, complete Part III and date, sign, and return the questionnaire to the NSBF.
   If yes, complete entire questionnaire and return.

5. Number of Flights:____One successful______________________________

6. Flight Date(s):(1)___June, 2001___________________(2)______________

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7. Launch Site(s):(1)____Palestine, TX_________

8. Launch Site Arrival Date(s):(1)_ May 15, 2001______

9. Dimensions of Scientific Payload:(1)_2.5m x 2.5 m x 4 m____
(Enclose Drawings or Photo if available)

10. Estimated Weight of Scientific Payload (experimenter-supplied equipment only including batteries):
(1)__Approx. 700 kg__________________

11. Desired Float Altitude (feet):(1)____125,000___________

12. Desired Time at Float Altitude:(1)___8 hours____________

13. Desired Launch Time (Time of Day):(1)_any____________

14. Describe other than normal flight profile requirements - e.g., altitude variations, ascent/descent rates, valving, payload reel down, altitude stability:
________None____
____
____

15. The NSBF normally provides steel shot as ballast. Non-magnetic ballast, e.g, glass shot or lead shot may be used if justified by science requirements. Please indicate your requirement.
Steel______OK______________ Non-Magnetic_________________________.

16. Are there any restrictions on the proximity of the scientific payload to other equipment, electronics, ballast, or to the balloon? List any special balloon design requirements that you may be aware of e.g., no radar reflective tape, attached ducts, minimum poly powder lubrication, etc.
____________None____
____
____

17. A. Has this payload been flown before by the NSBF?

No__X_____ Yes___X___Site____Alice Springs_________Date___several___
Last Flight Number:__________

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PRE-FLIGHT SUCCESS CRITERIA

Notes:

1. The NSBF always strives to meet the comprehensive success criterion as established by the experimenter. Therefore, unless a reasonable chance exists of meeting that criterion as stated, the flight application will be deemed unacceptable.

2. At the launch site, the NSBF will make every effort to meet the comprehensive success criterion. Under no circumstances will the NSBF attempt to launch your experiment unless the minimum success criterion can be met.

Please type or print legibly.

1. Briefly state the minimum scientific objective which must be met to achieve a mission success.
   Observe atmospheric gamma radiation at high altitude for
   at least three hours.

2. Balloon Performance Requirements:

   Float Duration (Hrs) - Desired 8 ; Minimum Acceptable 5

   Float Altitude (Ft) - Desired 125,000 Minimum Acceptable 115,000

   Altitude Stability - Desired +/- 2000 Minimum Acceptable +/- 5,000

   Describe other than normal flight profile requirements - e.g., altitude variations, ascent/descent rate, valving, payload reel down, altitude stability):
   None

3. Define any NSBF support systems (telemetry, commanding, recovery, etc.) performance requirements with desired and minimum criteria.

   No special requirements

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4. Experiment Performance - Detectors, Pointing Systems, etc. (Give a summary of the desired and required performance for the experiment.

   Detector subsystems should all operate successfully at float for at least one hour.

   Goal is to take at least 5 hours of data at float.

5. Provide details on any other data source or support element separate from the balloon flight but necessary to achieve mission success (e.g., instrumented sounding balloons, instrumented aircraft, satellite overpass, independent ground station measurements, National Weather Service Radiosonde Data).

   None

6. Proposed Data of Flight June , 2001

   Launch Site Palestine

David J. Thompson
Name (Type or Print)

NASA/GSFC
Organization

Signature

Date